

Age:

Approximately 10+ (Depends on parental permission and/or teacher comfort level)

Cost:

Approximately \$5 - 7 each

Difficulty:

Easy

Danger:

Small parts can pose a possible choking hazard if swallowed

Review and follow battery safety rules (below)

Overview:

Bristlebots are an inexpensive vibrating robot [or vibrobot] that can be built using common items found around a home or purchased online. They are, typically, composed of a toothbrush, a motor, and a battery. Bristlebots only take a few minutes to assemble and can be made in any shape, size, colour, or configuration.

Outcomes:

- To introduce students to painting, non-representational or abstract art, kinetic sculpture, performance art, etc...
- To introduce students to the importance of safety, cleanliness, brush maintenance, etc...
- To introduce students to electrical and battery safety, electricity, circuits, design, physics, engineering, etc...
- To introduce students to troubleshooting (or systematic problem solving)
- To encourage teamwork, observational learning, kinaesthetic learning, arts-based inquiry, problem solving, etc...
- To encourage creative uses of technology: Bristlebots can Race, Wrestle, and even be set loose inside of a Maze!
- Bristlebots easily be integrated into either a student or teacher-guided lesson or activity.

Materials:

- Toothbrush (remove the handle)
- Pager/Vibrating Motor
- Battery (coin, AA, or AAA)
- Foam Tape or Electrical Tape
- Pipe Cleaners
- 'Goggly" Eyes
- Scissors and/or Wire cutters

Procedure:

- Remove the handle from your toothbrush. Keep only the top (brush-end)
- Place a piece of foam tape on the top of your brush
- Attach a battery to the brush (Remember, you can move/adjust it at any time)
- If your tape is completely covered by the battery, please place another piece to your toothbrush
- Tape/attach your motor to your toothbrush (Remember, you can move/adjust it at any time)
- Connect/tape the two wires from you motor to your battery
 - One wire to "+" and one to "-". (You may need to detach your battery to do this)

- The configuration should not matter and the battery/motor should just work
- **Tip:** Use blue sticky tack (poster putty) to attach all of your components and wires
- **It will Buzz. Your Robot is finished!**
- Put it on the floor and let it loose

Optional:

- Attach 'Googly' eyes to your Bristlebot
- Attach pipe-cleaner "legs" to help balance your Bristlebot

Painting:

- Power off your Bristlebot
- Remove the battery and motor assembly
- Dip your brush into (non-toxic) paint
- Wipe off the excess
- Power on your Bristlebot
- Attach your battery and motor assembly
- Place your Bristlebot onto a canvas or sheet of paper and let it loose

Cleaning:

- Power off your Bristlebot
- Remove the battery and motor assembly
- Rinse your brush in soapy water
- Use your fingers to scrub the brush
- Rinse (thoroughly)
- Repeat until the water runs clear
- Dry (thoroughly)
- Attach the battery and motor assembly
- Let it loose

Storage:

- Power off your Bristlebots
- Disconnect the batteries from the motors
- Place all dangerous materials into a child-safe container
- Store these materials out of reach of small children and out of direct sources of heat or light

Tips:

- Bristlebots will break, fall over, or need a lot of TLC to work.
- Students may become frustrated or irritated.
- Encourage students to troubleshoot, or problem solve, their own robots.
- The issue is typically attaching the wires to the battery.
- Use blue sticky tack (poster putty) to attach all of your components and wires.
- "Engage students in a discussion of their procedure and techniques, to explore difficulties encountered, as

well as ingenious solutions."

-- from <http://teachers.egfi-k12.org/activity-do-it-yourself-bristlebot/>

"Then, challenge them to consider — and devise — design modifications. What would happen if the toothbrush bristles were not straight? What could be done to the BristleBot to make it go in circles? Could a similar vibrobot be made from a flat-topped dust broom or a hair comb?"

-- from <http://teachers.egfi-k12.org/activity-do-it-yourself-bristlebot/>

Questions:

- How does your robot work?
- What should you do if your robot doesn't work?
- Does it matter where you put your battery or motor?
- What happens when you move your motor/battery?
- How can you use pipe-cleaners to balance your robots?
- What happens when you connect your robots together?
- What happens when you put two motors on one robot?
- What does abstract mean?
- How could we make art with our robots?
- Could we attach our motors to a paintbrush? What would happen?

Battery Safety:

- Always supervise children when they play and teach them how to play safely
- Keep batteries away from any sources of water
- Do not allow batteries to be placed into student's mouth (Do not allow students to put any of the materials for this project into their mouths)
- If a child swallows a battery take them to the hospital right away and do not allow them eat or drink anything
- Never connect the '+' end to the '-' of a battery directly (single wire without a motor, light, etc)
- "Batteries contain harmful substances, like acids and heavy metals. If batteries are not correctly used, stored and discarded, these harmful substances may leak, or the batteries may overheat or burst. If batteries are swallowed, they may be poisonous, requiring immediate medical attention." <http://www.hc-sc.gc.ca/cps-spc/child-enfant/toys-jouets/batteries-piles-eng.php>
- <http://www.hc-sc.gc.ca/cps-spc/pubs/cons/batteries-piles-eng.php>
- Battery safety video: <http://www.ksl.com/?nid=1009&sid=19252364>
- Another video: <https://www.youtube.com/watch?v=c8K3anHxmRQ>

Resources:

- Motor <http://www.robotshop.com/ca/productinfo.aspx?pc=RB-Sbo-46&lang=en-US>
- Battery <http://addison-electronique.com/>
- Bristlebots.org
- Instructables.com
- <http://www.evilmadscientist.com/2007/bristlebot-a-tiny-directional-vibrobot/>
- http://www.makershed.com/Build_your_own_scuttling_BrushBot_p/msbb.htm
- <http://teachers.egfi-k12.org/activity-do-it-yourself-bristlebot/>
- <http://www.techeblog.com/index.php/tech-gadget/video-bristlebot-2-0-robot-made-from-computer-chip>